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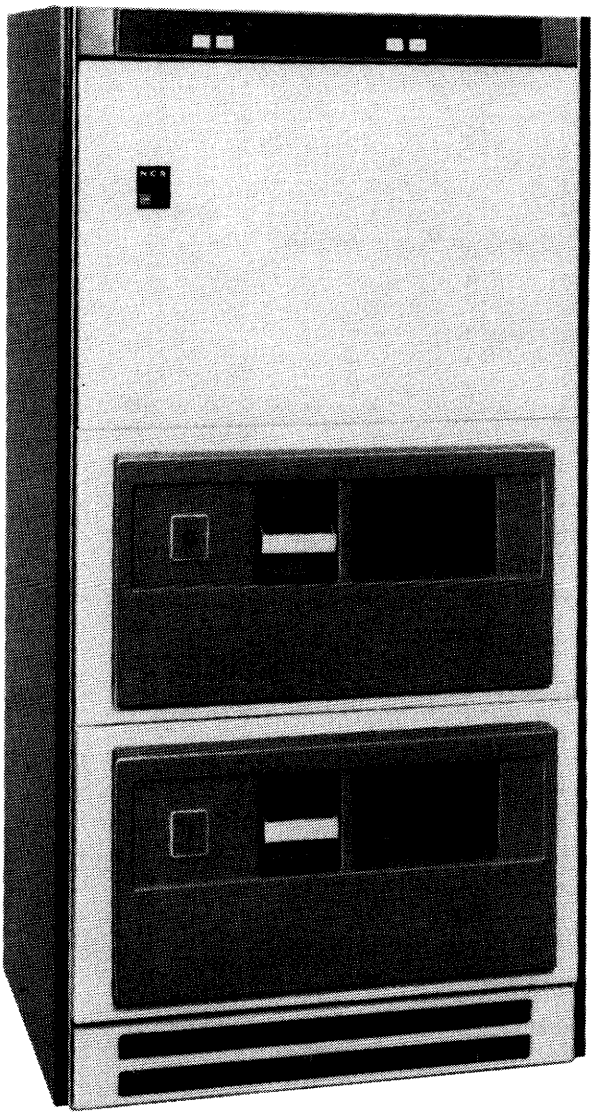
FREESTANDING HIGH-CAPACITY DISC UNIT

657-101, 657-102



This publication contains the physical and functional descriptions of the 657-101/102 high-capacity disc units. It is written with the assumption that the reader is familiar with magnetic storage media and has a knowledge of the basic disc storage and recording concepts. Persons unfamiliar with magnetic storage concepts should refer to PRODUCT INFORMATION MANUAL, MAGNETIC FILE PERIPHERALS, Pub. No. 2, "Basic NCR Disc Concepts."

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INTRODUCTION

General

The NCR 657-101/102 is a high-capacity disc unit, housed in a standard high-boy cabinet. The 657-101 is a single drive unit (one unit in a cabinet); the 657-102 is a disc drive doublet (two units in a cabinet). Each disc drive, housed in a pull-out drawer in the cabinet, accommodates a removable 957-1 disc pack with a storage capacity of up to 47.5 megabytes. The storage capacity is dependent on the system configuration, the recording density, and the mode of disc formatting.

Features

- High Capacity -- Up to 47.5 megabytes of information per pack; up to 4 disc drive doublets in a subsystem for a total of 380 megabytes of data, available on one position of the common trunk.
- High Performance -- 315kb or 500kb data transfer rate.
- Random Access -- 203-position, multispeed, bi-directional actuator, positioning 20 read/write heads in each spindle, with an average access time of 60 milliseconds.
- Simultaneity -- Up to seven disc units performing a "seek" operation, while one unit is transferring data.
- High or Low Density -- Data can be recorded at 2200 bits per inch or 3500 bits per inch.
- Hardware Controlled Alternate Tracks -- After initialization of the disc pack, hardware seeks the alternate track which replaces a defective track. No software intervention is required.
- Compatible -- Programs compiled for the NCR 655 disc unit can be copied and run on the NCR 657 disc unit without recompilation. (For maximum efficiency, however, recompilation is recommended.)

  Data media used on the NCR 657 is the industry-compatible disc pack, composed of 11 discs with 20 recording surfaces.

  Disc packs are physically interchangeable with competitive discs. NCR's proprietary recording method makes data interchange impossible between discs recorded on the NCR 657 and discs recorded on other disc drives.

  Disc packs are interchangeable between two NCR 657 disc drives, as long as the recording density is observed.

- Ease of Maintainability -- Offline testing of one disc drive while the remaining units are operating online.

DISC PACK

Physical Description

The disc pack used for data storage is the 957-1. The pack consists of 11 recording discs and two protective, non-recording discs. Of the top and bottom recording discs, only the inside surfaces are used for data storage. The magnetic recording surface is a coating of iron oxide on the base material.

The pack is protected from contamination by removable dust covers. The disc pack is approximately 6 inches high, 14 inches in diameter, and weighs 14 pounds.

Disc Pack Organization

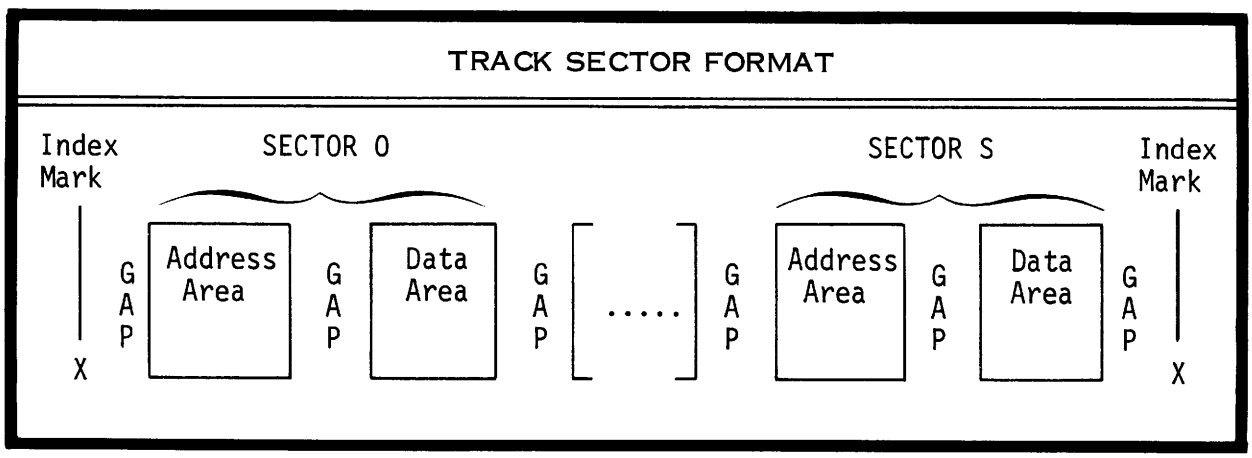
- Track Formatting

Each recording surface has 203 circular recording tracks. Of the 203 tracks, up to 5 tracks (normally 3) may be reserved as alternates for tracks that become defective and unusable. Each track can be accessed by a single read/write head that is positioned by a 203-position actuator. The recording tracks are spaced about 1/100 inch apart, or approximately 100 tracks to an inch of the recording surface.

At any one given time, each read/write head is in position to read or write data on one track on each of the 20 recording surfaces. These 20 tracks of available data are known as a cylinder.

Each disc pack has a notch in the bottom disc (the non-recording disc) to indicate the physical beginning of all tracks. This notch is the index mark of the pack.

Each data track may be divided into sectors of equal length to permit variable record organization and provide maximum utilization of the data storage capacity. Three modes of sectoring are provided: 1 sector per track, 8 sectors per track, or 16 sectors per track. Each sector has a data area and an address area separated by gaps. The length of the gaps varies, depending on the formatting mode used and the location of the gap on the track. In addition to the address area and the data areas, certain control information is recorded in each sector to be used by the Disc Control Unit (DCU) during data transmission to and from the disc.



- Density

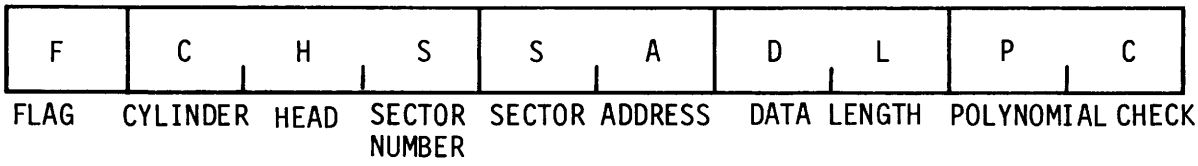
Recording of data on the disc can be in one of two denstiy modes: 2200 bits per inch or 3500 bits per inch. The recording density is dependent on the system configuration (system bandwidth) and the type of DCU.

- Addressing

Addressing of data sectors is an extension of the 655 addressing mode. A 16-bit binary sector address (SA) is converted to three bytes that specify the cylinder, head, and sector (CHS) number. Both versions of the address are recorded in the address area of the disc.

Each address area is 10 bytes long. These 10 bytes specify the location on the disc of the data area that follows the address area, and contain control information connected with the track condition and data checking.

ADDRESS AREA BYTE DESCRIPTION



The information contained in the address area performs the following functions.

DESCRIPTION AND FUNCTIONS OF ADDRESS AREA BYTES

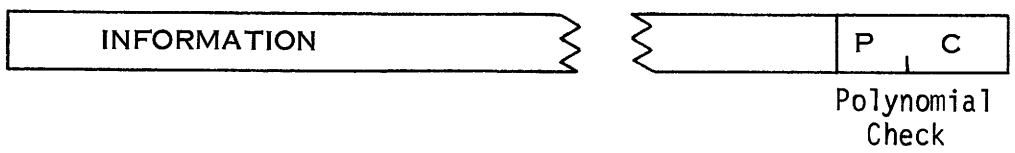
BYTE DESCRIPTION	BYTE NUMBER	FUNCTION
Flag (F)	1	This byte indicates special and normal track conditions as shown: Bit 1 -- Zero: Indicates a primary track. One: Indicates an alternate track. Bit 2 -- Zero: Indicates a good track. One: Indicates a defective track. Bit 3 -- Zero: Normal One: Indicates that the track was formatted from the maintenance panel of the DCU. Bits 4 to 7 -- Not used. Bit 8 -- Used to detect a missing address marker. Bit 8 is set to zero in the first address area and alternated for each succeeding address area.

DESCRIPTION AND FUNCTIONS OF ADDRESS AREA BYTES [CONT.]		
BYTE DESCRIPTION	BYTE NUMBER	FUNCTION
Address (CHS)	2-4	These three bytes contain the cylinder, head, and sector number of the data area that follows this address area. This is the physical address of the data area. It is derived from the 16-bit sector address.
Address (SA)	5-6	These two bytes contain the binary sector address, as used in the PAF. This binary number, identifying the data area that follows this address area, is used to verify the conversion from the sector address to cylinder, head, and sector number by the DCU.
Data Length (DL)	7-8	These two bytes specify the maximum number of bytes reserved as the data area, excluding the two polynomial check bytes.
Polynomial Check (PC)	9-10	Error detection bytes. These two bytes are used to verify that the data which was read is error-free.

- Data Area

The data area, separated by a gap, follows the address area. The length of the data area may range from one to the maximum number of bytes specified by the sectoring mode of the track. If the information in the data area occupies less than the specified number of bytes, the DCU fills the rest of the area with a special sequence of recording bits called "idle bytes." This makes the use of variable length records practical. The two bytes used for the polynomial check in the data area perform the same function as they do in the address area.

DATA AREA DESCRIPTION



- Disc Capacity

The capacity of the disc is dependent on the mode of sectoring and the density of recording. The figures in the following illustration are based on one sector per track, including the spare tracks (three per recording surface) used for alternates. As the number of sectors per track increases, the address area of each sector and the gaps separating the sectors reduce the total data area and the capacity of the disc.

DISC CAPACITY *

DATA	PER TRACK	PER CYLINDER	PER PACK
Cylinders	-	1	203
Tracks	1	20	4060
Bytes - Low Density	7,461	149,220	29,844,000
Bytes - High Density	11,884	237,680	47,536,000

* Complete storage specifications may be found under "Functional Specifications" in this publication.

- Disc Capacity in System Environment

If the disc is formatted to contain one sector per track, it can be used only as a format 9 pack; that is, for data files and not as a system disc. Only hardware read and write routines can be used with the disc pack formatted to contain one sector per track.

The following table shows the effective data storage capacities of the disc pack in various formats and recording densities.

DISC CAPACITY IN SYSTEM ENVIRONMENT

SECTOR & DENSITY	FORMAT 1	FORMAT 9
LOW DENSITY		
1 Sector/Track	N/A	29.3 megabytes
8 Sectors/Track	24.2 megabytes	25.4 megabytes
HIGH DENSITY		
1 Sector/Track	N/A	47.0 megabytes
8 Sectors/Track	40.5 megabytes	42.7 megabytes
16 Sectors/Track	37.1 megabytes	39.2 megabytes

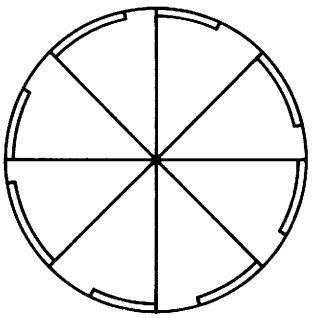
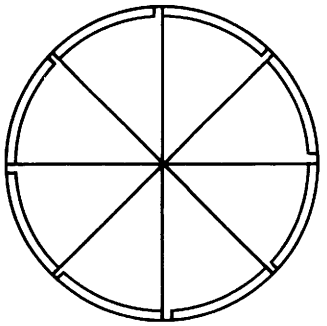
The storage area on the disc that is currently taken up by the system software is illustrated in the following chart.

SYSTEM SOFTWARE STORAGE AREA			
DISC FORMAT	1 SECTOR/TRACK	8 SECTORS/TRACK	16 SECTORS/TRACK
Format 1	N/A	246 tracks	154 tracks
Format 9	64 tracks	64 tracks	62 tracks

Data files may share the same disc with the system software. Compatibility between the 655 and the 657 disc units is achieved by copying the present data from the 655 disc to the 657 disc. However, since the capacity of a sector on the 655 is only 512 bytes, the data area that is not utilized is quite extensive, even with the 657 formatted in the 8 sectors/track mode. It is in the interest of the user to recompile all programs and specify data block sizes on the specifications worksheets that make the most efficient use of the 657 storage area.

The following illustration shows the effective storage capacity of the NCR 657 before and after recompilation of programs. The disc pack is formatted to contain 8 sectors per track. Data is recorded in low density.

NCR 657
EFFECTIVE DISC CAPACITY — BEFORE AND AFTER RECOMPILATION

	SECTOR USAGE	BUFFER SIZE	PACK CAPACITY
BEFORE RECOMPILATION		512 BYTES	16,384,000 BYTES
AFTER RECOMPILATION		**812 BYTES**	**25,984,000 BYTES**

Compatibility

Physically, the disc pack is interchangeable with discs of other manufacturers. However, NCR's proprietary recording method makes data interchange impossible between disc packs recorded on the NCR 657 and disc packs recorded on equipment manufactured by others.

Disc packs are interchangeable between two 657 disc units as long as the density of recording and the data transfer rate capability of the system is observed.

PHYSICAL DESCRIPTION

Cabinet

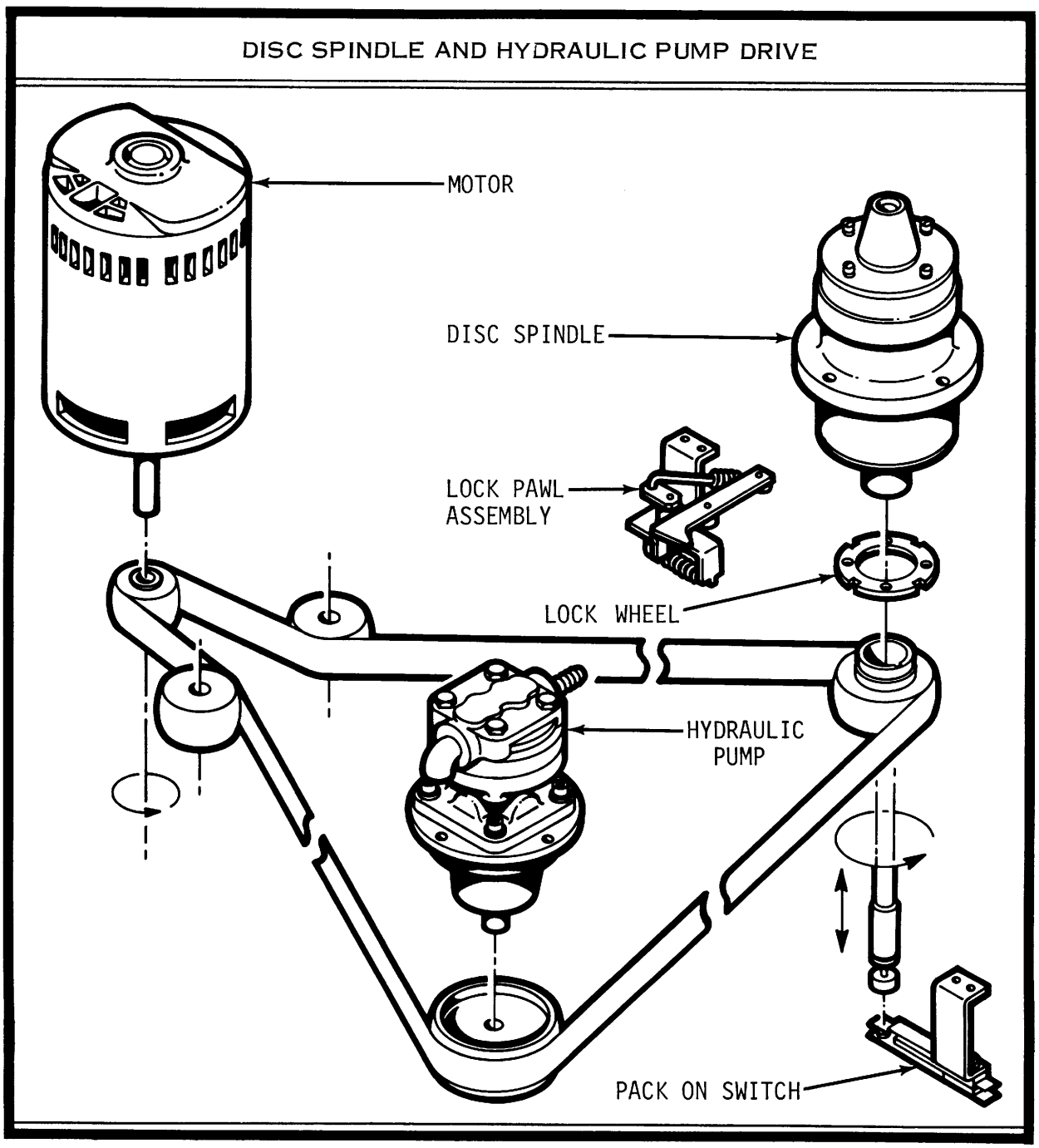
The NCR 657 disc unit is housed in a standard 66 X 32 X 27 inch high-boy cabinet. The mechanical drive for the disc spindle is housed in a pull-out drawer. One or two disc drives and their associated control and read/write circuits are contained in one high-boy cabinet. The pull-out drawers provide a locking feature that prevents powering up of the drive until the drawer is securely seated in the cabinet. The disc drive can be removed from the rear of the cabinet for easy access during maintenance or trouble-shooting.

Disc Drive Spindle

An electric motor provides the power to turn the disc spindle and the hydraulic pump that drives the actuator to position the read/write heads. The disc spindle, assembled to the spindle shaft, has a conical guide to facilitate mounting of the disc. When the disc is mounted, it has to be turned clockwise until the spindle and the pack have been bonded together and the top dust cover is loosened for removal. Also assembled to the spindle shaft is a detented lock wheel. A spindle lock pawl, operated by the pull-out drawer, is resting in one of the teeth of the detent, holding the spindle securely until the disc pack has been fully mounted and the drawer shut. Closing the drawer retracts the pawl to free the spindle shaft.

When the unit is powered up, the spindle and the disc pack turn at the speed of 2400 rpm. When the unit is powered down, a dynamic brake utilizing the drive motor slows the disc to a stop. The stopping cycle requires approximately 5 seconds.

Under the spindle shaft is a switch that is operated by a pin extending through the shaft. When the disc pack is mounted, the end of the pin moves down and closes the switch. This generates a logic term, indicating that the pack is mounted securely.

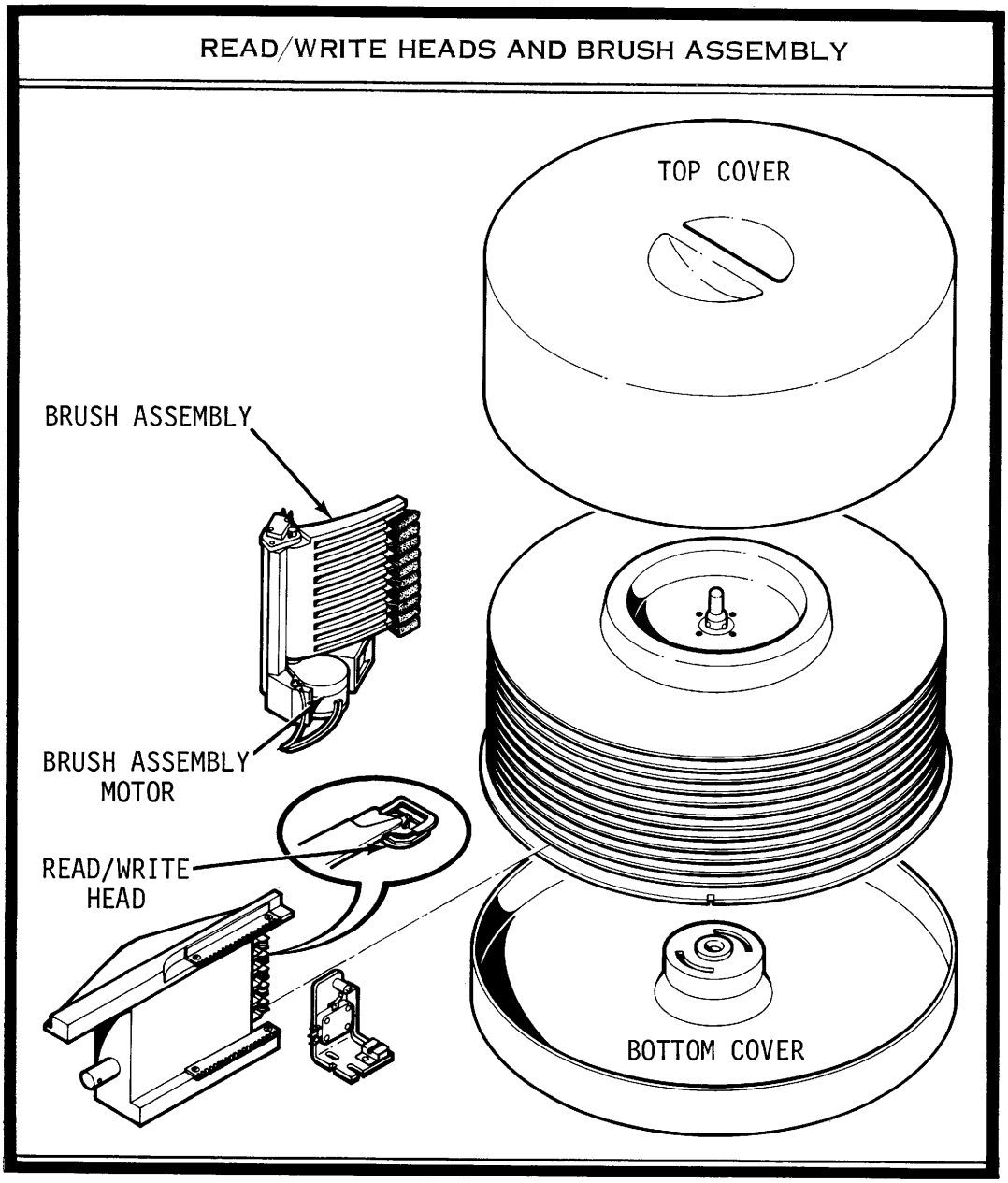


Brush Cycle

Powering up the unit also starts the brush assembly motor. The brush assembly contains 20 brushes which sweep the 20 recording surfaces prior to the loading of the read/write heads. The brushes remove any foreign particles from the surfaces of the disc. The brush cycle duration is approximately 60 seconds. The brushes are fully retracted before the read/write heads are positioned over the recording areas.

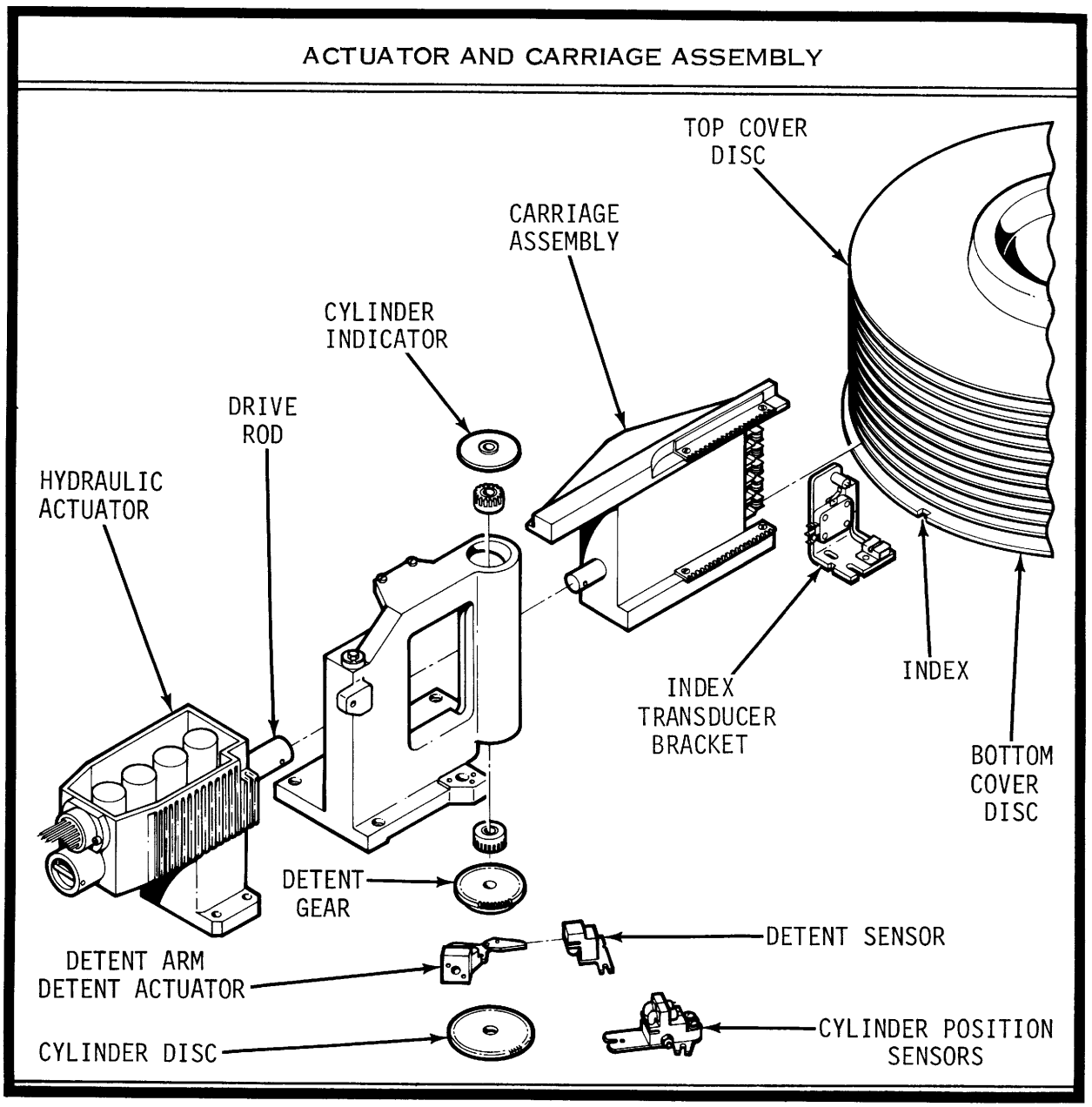
Read/Write Heads

Each recording surface is accessed by one read/write head. All 20 heads are assembled on the same access arm and move as a unit. Heads are numbered from 0 to 19. (The designation of any one particular head is part of the addressing scheme to access a data area.) The head assembly consists of the read/write head mounted in a gliding shoe. In the unloaded position the heads are held up by a flexible shaft. When the heads are moved over the surface of the rotating disc, the flexible shaft is rotated and the heads are lowered. The air bearing holds the gliding shoe portion of the head assembly approximately 80 microinches off the surface of the disc. The movement to the flexible shaft is reversed to raise the heads and hold them off the surface of the disc prior to stopping the disc.



Actuator and Carriage Assembly

The motor that drives the disc spindle also operates a pump that drives the hydraulic actuator. The pump has a capacity of 2.5 cubic inches per second, which develops a pressure of 300 psi. The pressure is reduced to the desired levels by various valves and orifices in the hydraulic actuator.



Four solenoid-operated valves control a drive piston in a cylinder. The drive piston can be moved in two directions at three different speeds. When the disc has reached its operational speed of 2400 rpm and the brush cycle is completed, the head loading sequence starts. Through control logic, the extend solenoid energizes, extending the carriage assembly and loading the 20 read/write heads. Energizing the extend solenoid places the drive piston in the hydraulic "home" position.

Forward or reverse fast is accomplished by energizing the forward-reverse solenoid. The speed of the fast movement depends on the capacity of the pump. The cylinder is moved at fast speed until the assembly is 20 cylinders away from the desired one. At that time the intermediate solenoid energizes and slows the access drive piston down to 7.5 inches per second. When the assembly is 3 cylinders away from the desired one, the slow solenoid is energized which slows the piston down to 1.4 inches per second in the forward direction or 1.8 inches per second in the reverse direction.

The access drive piston is connected through a drive rod and coupler to the carriage assembly. When the actuator is extended and the heads loaded, any additional movement to the drive piston positions the carriage towards the center of the disc or away from it, depending on the direction of travel.

The carriage assembly has two geared guide rails that are in mesh with two intermediate pinions. The pinions are fastened to the detent shaft which may rotate either clockwise or counter-clockwise. Fastened to the detent shaft are the cylinder disc, the detent gear and the cylinder indicator.

The cylinder disc is a slotted wheel which rotates with each carriage movement. The slots are used to sense the lateral movement of the carriage and head assemblies. When the cylinder disc moves from one cutout slot to the next, the carriage assembly has been positioned an equivalent distance of two tracks laterally. The cylinder disc moves circularly a total of 351°. The total lateral movement of the carriage within the recording area is 2 inches.

The detent gear works with the detent arm that fits into the teeth of the gear. When the detent solenoid is activated, the detent actuator is relaxed. The arm moves into the teeth of the detent gear by spring tension. The hydraulic pressure to the drive piston is reduced and the carriage with the read/write heads comes to a stop.

Access and Latency Times

The carriage actuator moves the read/write heads to an adjacent track in 17 milliseconds. The maximum head movement time is 115 milliseconds; the average time is 60 milliseconds. The disc rotates at 2400 revolutions per minute or one rotation every 25 milliseconds. The average latency time is 12.5 milliseconds.

Logic and Drive Circuits

The upper bay of the high-boy cabinet contains the following logic and drive circuits necessary for the operation and control of each disc drive.

- Difference Counter -- The number of positions that the actuator is to move is computed by the DCU and then stored in the difference counter. The output of the counter is decoded to develop the detent, intermediate, and slow control signals to the hydraulic actuator. When the counter is decremented to zero the access drive piston stops.
- Head Number Register -- A binary register for storing head numbers 0 through 19. It contains the number of the read/write head used on this operation.
- Miscellaneous logic circuits to indicate ready status, pack-on condition, seek-started, seek-completed, inoperative conditions (air-flow below velocity, drawer open, power off), etc.

Unit Controls

The unit controls on the cabinet are the Stop and Start switches. These are used to start and to stop the individual disc drive units. The disc drives may also be brought to a stop by the program issuing a "stop drive" instruction. The AC power to the disc units is supplied by the DCU. Four indicators on the control panel indicate the state of each disc drive units. The indicators and their functions are:

- Ready -- The disc unit is operative, the disc pack is mounted, and the unit may be selected for data transfer.
- Active -- The disc unit is busy handling a command from the DCU.
- Check -- The disc unit has detected a malfunction and requires operator or program intervention.
- Command Stop -- The disc drive was stopped by the program issuing a "stop drive" instruction.

FUNCTIONAL DESCRIPTION

System Requirements

The NCR Century Operating Systems require the use of at least two discs which must be mounted on two NCR 655 spindles or on two NCR 657 spindles. On an NCR 657 disc unit, the operating system software occupies approximately six percent of the total disc capacity.

The NCR 657 disc unit can function with either the NCR Century 200 or 300. Because of its high transfer rate, it cannot be used on the NCR Century 100. The 657 is a freestanding disc unit to be used with either a 625-201 (low density only) or a 625-202 (low or high density) Disc Control Unit.

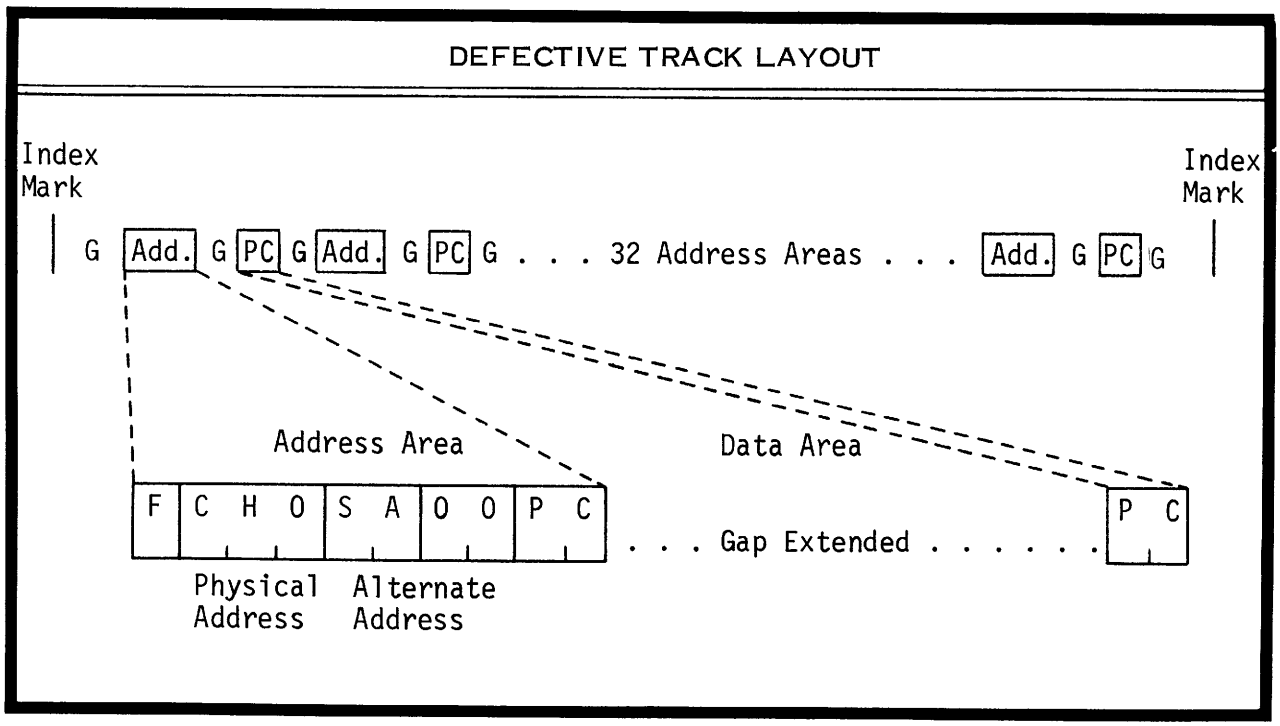
On the NCR Century 300, the disc unit may operate in any of the three modes of formatting: 16 sectors/track, 8 sectors/track, or 1 sector/track. Data may be recorded in either low or high density. This is possible with the 625-202 Disc Control Unit, which may be set, under program control, for either mode of density. Data transfer rate in the high density mode is 500kb. Any trunk, except the multiplexor trunk (trunk 0), may be used to accommodate the 625-202 Disc Control Unit and the 657 disc. If desired, the 625-201 DCU may be used on the NCR Century 300. However, this limits the recording density to the low mode.

On the NCR Century 200, the disc unit may operate in either the 8 sectors/track or the 1 sector/track format. Data can be recorded only in the low density mode, with a transfer rate of 315kb. As a result, the 625-201 Disc Control Unit is used on the NCR Century 200. The system must contain the high-speed trunk option to accommodate the disc unit and the DCU.

The NCR 625 DCU is a level one, common trunk peripheral. The DCU controls up to eight 657 disc drives. The disc units can be either the 657-101 or -102 models (single or doublets). However, if a single unit is housed in a cabinet, the total capacity of the subsystem is reduced, since the controller can accommodate up to four disc cabinets, whether they house single units or doublets.

Alternate Track Assignment

One of the features of the NCR 657 disc unit is the automatic selection of alternate tracks by hardware, without program intervention. The assignment of alternate tracks is done by software when the disc is initialized. The format routine assigns an alternate track to replace a defective one. If an attempt is made during the running of a program to access the defective track, the alternate track is automatically accessed. The address of the alternate track is recorded in multiple address areas of the defective track, with the defective track flag set in each flag area. Since the exact location of a defect is indeterminate, the multiplicity of alternate track addresses ensures that some of them are recorded in a good area of the track.


DEFECTIVE TRACK LAYOUT
Index Mark
Index Mark
G Add. G PC G Add. G PC G . . . 32 Address Areas . . . Add. G PC G
Address Area
Data Area
F C H O S A O O P C
. . . Gap Extended . . . . . .
P C
Physical Address
Alternate Address

Input/Output Operations

- Selection

All I/O operations are initiated by the processor with the execution of an I/O command. During the execution of the command, the processor transmits to the DCU a series of PAF characters. The DCU responds to these with a character-received signal until all the necessary information has been received. If for some reason the DCU cannot respond within a specified time, the processor terminates the selection and stores the appropriate S-2 status, indicating the result of the selection attempt. If the trunk is not busy and the DCU and the disc units are operational, an S-2 status of "command initiated" is stored by the processor and the I/O command terminates. The processor continues internal processing, while the DCU and the disc unit seek the data location and start to transmit data.

The Peripheral Address Field for the selection of a disc control unit and a specific disc consists of six bytes as shown below.

PERIPHERAL ADDRESS FIELD					
87654321	87654321	87654321	87654321	87654321	87654321
TTT PPP	UUU	FFFFFFFF	S/A	S/A	NNNN

T = Trunk Number

P = Position Number

U = Unit Number

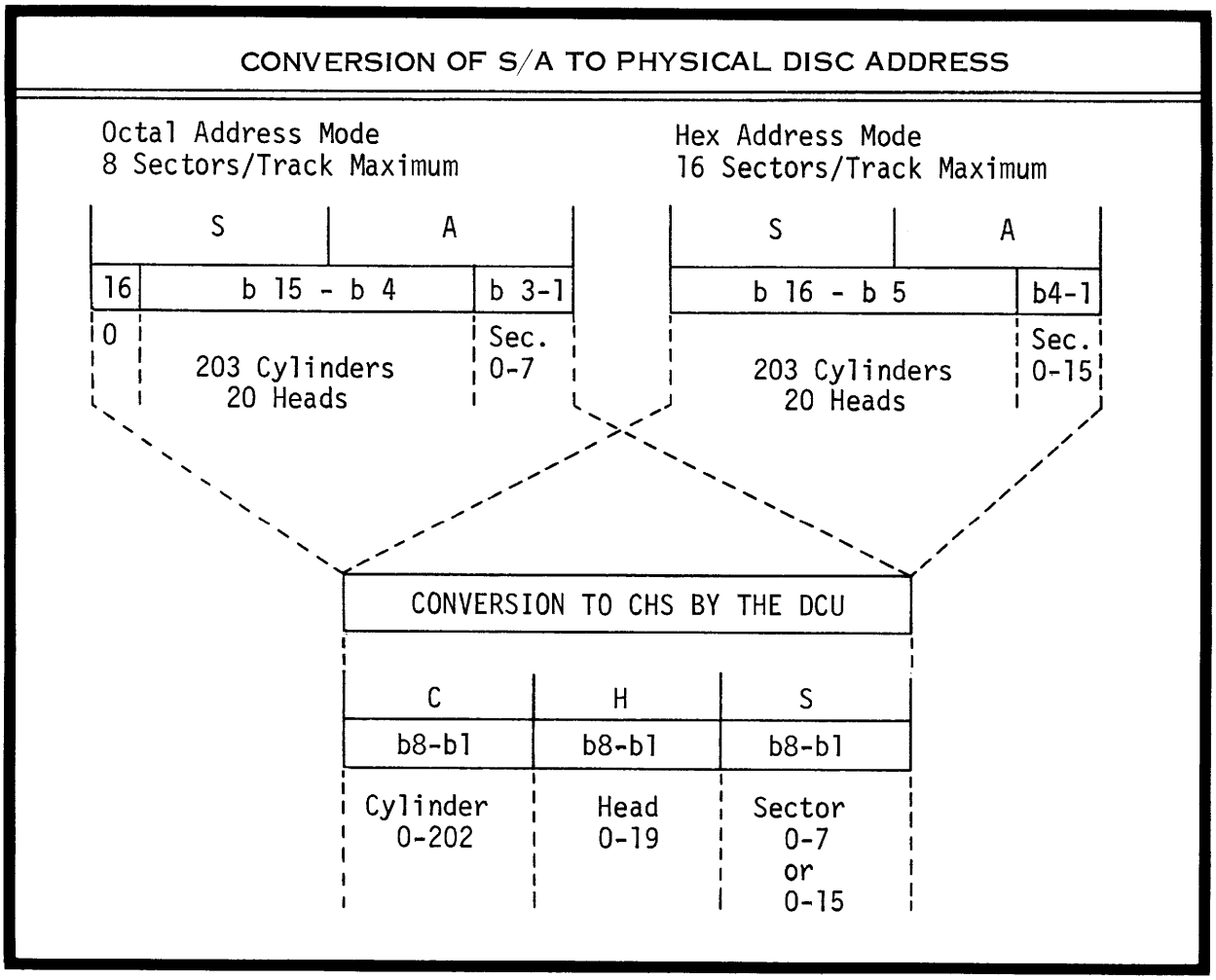
F = Function Code

S/A = Sector Address

N = Number of additional sectors used in performing the function specified by the function code.

- Trunk Number -- Designates the number of the trunk that has the DCU connected to it.
- Position Number -- Designates the position on the trunk that is occupied by the DCU.
- Unit Number -- Specifies which of the eight possible disc units is to perform the function specified by the function code.
- Function Code -- This byte defines the function to be performed by the selected disc unit. The function code byte is used by the DCU to issue control instructions to the various disc units associated with reading or writing of data. A listing and detailed explanation of the functions may be found in this manual under Magnetic File Peripherals tab, 625-201/202 Disc Control Unit.

- Sector Address -- Two bytes used to designate the sector address (SA). The DCU converts the 16-bit sector address in the PAF into three distinct bytes which specify the cylinder, head, and sector (CHS) number on the disc. The address conversion to CHS numbers differs with the formatting mode. If the track is formatted at 8 sectors per track bit 16 must be zero, bits 4-15 designate the cylinder and head number, and bits 1-3 specify the sector number. In the 16 sectors per track format bits 5-16 designate the cylinder and head number, and bits 1-4 specify the sector number. Either conversion mode may be used if the disc pack is formatted to contain 1 sector per track, with the bits specifying the sector number equal to zero.



NOTE

After the disc unit has located the specified cylinder and selected the specified head, the DCU compares the physical CHS number and sector address (SA) recorded on the disc with the converted CHS number and the 16-bit sector address transmitted to the DCU in the PAF. This not only verifies correct data area location, but also provides a unique check of the address conversion by the DCU.

- Number of Sectors -- This byte designates the number of additional sectors with which the specified function is performed. The number of bits used in the N-byte varies with the address mode used when the track was formatted. If the octal mode is used, only the first three bits are used (to count from 0 through 7) to give a maximum number of 8 sectors per track. If the addressing mode is hex, the first four bits are used (to count from 0 through 15) to give a maximum number of 16 sectors per track.

- Response Number

With every request for service, the DCU transmits a unit response number byte that specifies the control word used in conjunction with the I/O flow. Only the six least significant bits of the unit response number are used. Bits 7 and 8 must be zeroes. Of the six bits used, the three most significant ones are determined by a plug-in card in the DCU. The three least significant bits designate the disc drive from 0 through 7.

- Data Transfer

The DCU computes the difference between the old and new cylinder addresses and stores the difference in the difference counter of the disc unit. To complete the address transfer, the head number is stored in the respective register in the disc unit. The disc unit now starts an independent seek operation. When it locates the specified cylinder, the disc unit signals the DCU, which begins a comparison of the cylinder, head and sector numbers read by the specified read/write head. When the numbers compare, the DCU requests service from the I/O control. During the execution of a read function the data area is read and the data transmitted to the DCU as an analog signal. The DCU detects and deserializes the data and transmits it parallel by byte to the I/O control. During the execution of a write function, data is transmitted parallel by byte to the DCU. The DCU serializes the data and sends it serially by bit to the selected disc unit.

- Termination

The processor terminates the I/O command when it has sent a sufficient number of control characters to the peripheral unit and an S-2 status character is received from the peripheral.

Termination of an I/O flow is normally initiated by the I/O control or the peripheral unit. Abnormal termination may be initiated by either unit as a result of an error condition or equipment malfunction. An S-3 status character is stored in the control word to indicate the results and terminating cause of the data transfer. If an error condition inhibits the transmission of an S-3 status character, the I/O control generates and stores an S-4 status character in its place.

- Status Character Transmission

At the termination of the I/O command, the processor stores an S-2 status character to reflect the result of the selection attempt.

S-2 STATUS CHARACTERS	
STATUS	HEX CONFIGURATION
COMMAND INITIATED	40
INOPERATIVE	02
BUSY	80
LOCAL (STANDBY)	82

If the I/O control detects a memory error or a programming error, it transmits an error signal to the DCU. The DCU deselects the disc unit that was selected at the time the error occurred and terminates the function. No terminating S-3 status character is sent to the I/O control. Instead, the I/O control generates and stores a latent error S-4 status character in the appropriate location in memory. If an error occurs during the transmission of an S-3 status character, the I/O control ignores the S-3 status, generates an S-4 "transmission error" status character and stores it in place of the S-3 status character.

S-4 STATUS CHARACTERS	
STATUS	HEX CONFIGURATION
LATENT MEMORY ERROR	84
LATENT PROGRAM ERROR	88
TRANSMISSION ERROR	81

In addition to termination by the I/O control or the DCU, the 657 disc unit, as a result of malfunctions or operator errors, can initiate termination of the I/O flow and generate an S-3 status character.

The following chart lists the terminating conditions that are detected by the disc drive, and the corrective action taken, if any.

S-3 STATUS CHARACTERS		
STATUS	HEX CODE	CORRECTIVE ACTION
OPERATOR MALFUNCTIONS		
Drawer is not closed Pack is not secured or protective cover is not removed Stopped drive	93 95 62	These conditions should be examined and corrected by the operator.
TRANSIENT MALFUNCTIONS		
Momentarily writing during reading Momentarily erasing during reading Not writing when requested More than one head is writing Momentarily writing during seeking Momentarily erasing during seeking More than one head selected, or illegal head number Multiple write	50 51 52 54 56 57 5B 61	These conditions can be corrected by the program. A RESTORE function should be performed and the operation tried more than once before the equipment is considered faulty. The disc pack may have some erroneous information stored in unspecified locations as a result of the malfunction.
SEEK MALFUNCTIONS		
Head load error or unable to load head Actuator speed above limits at detent time Detent did not engage within allotted time Seek not completed within allotted time	9D 9E 9C 58	These conditions can be corrected by the program. A RESTORE function should be performed and the operation tried more than once before the equipment is considered faulty.
PERSISTENT MALFUNCTIONS		
Airflow not within limits Pack below nominal velocity Brush cycle exceeds allotted time Stop sequence abnormal Persistently writing during reading Persistently erasing during reading Persistently writing during seeking Persistently erasing during seeking	98 9A 9B 9F 90 91 96 97	These conditions may be considered to be the result of faculty equipment. The disc pack may have some erroneous information stored in unspecified locations as a result of the malfunction.

SPECIFICATION

Physical

657—101/102 PHYSICAL SPECIFICATIONS		
CHARACTERISTIC	657-101	657-102
Dimensions		
Height	66 inches	66 inches
Width	32 inches	32 inches
Depth	27 inches	27 inches
Weight	450 lbs.	600 lbs.
Heat Dissipation	2,900 BTU/HR	5,200 BTU/HR
Cooling	Internal Fans	Internal Fans
Mounting	Leveling Jacks	Leveling Jacks
AC Power Requirements		
Voltage	120/208 VAC ± 10% 3 Phase 4 Wire	120/208 VAC ± 10% 3 Phase 4 Wire
Frequency	60 (±1) Hz	60 (±1) Hz
Current	2 Amps per leg	4 Amps per leg
KVA	1.0 KVA	1.7 KVA

C-957 DISC PACK PHYSICAL SPECIFICATIONS	
CHARACTERISTIC	DESCRIPTION
Dimensions	
Diameter (With Cover)	14.7 inches approximately
Height (With Cover)	6.0 inches approximately
Thickness of Disc	0.050 inches approximately
Weight	14 lbs. approximately
Composition of Recording Surfaces	Ferrous Oxide Coating
Number of Discs per Pack	11
Number of Recording Surfaces	20
Number of Tracks on Each Recording Surface	203

Functional

C-657 DISC UNIT FUNCTIONAL SPECIFICATIONS	
CHARACTERISTIC	DESCRIPTION
Type of Unit	Common Trunk
Type of Control	625-201/202 Disc Control Unit
Number of Disc Units Controlled by One 625-201/202	4 Dual Spindle C-657 Disc Units
Number of Access Arms	1 per Disc Drive
Number of Access Arm Positions	203
Number of Read/Write Heads Controlled by the Access Arm	20
Number of Bytes Available Without Repositioning Access Arm	237,680 - High Density 149,220 - Low Density
Head Positioning Time Maximum Minimum Average	 115 milliseconds 17 milliseconds 60 milliseconds
Disc Rotational Speed	2400 RPM
Revolutions per Second	40
Time per Revolution	25 milliseconds
Disc Rotational Latency	12.5 milliseconds
Data Transfer Rate	315kb or 500kb

DATA STORAGE SPECIFICATIONS				
DENSITY & FORMAT	SECTOR	TRACK	CYLINDER	PACK
LOW DENSITY				
1 Sector/Track	7,461	7,461	149,220	29,844,000
8 Sectors/Track	812	6,496	129,920	25,984,000
HIGH DENSITY				
1 Sector/Track	11,884	11,884	237,680	47,536,000
8 Sectors/Track	1,322	10,576	211,520	42,304,000
16 Sectors/Track	617	9,872	197,440	39,488,000

Environmental

The required environmental conditions for the NCR 657 disc unit are the same as they are for the NCR Century System with which it is used.

OPERATING LIMITS	
Temperature	68°F to 78°F Dry Bulb
Humidity	40% to 60% Relative
Altitude	7000 feet maximum
Leveling	± 3°

NOTE

For optimum performance, the disc pack should be allowed to acclimatize to the computer room by storing it in the computer room for a reasonable period of time before using it. The amount of time necessary for acclimatization depends on the environmental conditions of the last storage location. If the previous storage room has an environment nearly the same as that of the computer room, a minimum period of time would be required for the disc pack to become acclimatized. If the temperature and humidity differences are greater, a longer period of time would be required.

CAUTION

When the temperature of the disc pack is below 50° F, the disc pack should not be carried directly into the computer room environment. Disc packs should be allowed to acclimatize gradually in a general office-type environment to minimize the possibility of condensation forming on the disc surfaces.